AN ANALYSIS OF THE AQUATIC INVERTEBRATES AND HABITAT OF STREAMS IN THE BLACKFOOT RIVER WATERSHED

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FINAL

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by

Wease Bollman
Rhithron Associates, Inc.
Missoula, Montana

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INTRODUCTION

Aquatic invertebrates are aptly applied to bioassessment since they are known to be important indicators of stream ecosystem health (Hynes 1970). Long lives, complex life cycles and limited mobility mean that there is ample time for the benthic community to respond to cumulative effects of environmental perturbations.

This report summarizes data collected in late June 2001 from twelve sites on five streams in the Blackfoot River watershed, Lewis and Clark and Powell Counties, Montana. Aquatic invertebrate assemblages were sampled by personnel of the Montana Department of Environmental Quality (DEQ). Study sites lie within the Northern Rocky Mountain or Montana Valley and Foothill Prairie ecoregion (Woods et al. 1999). A multimetric approach to bioassessment such as the one applied in this study uses attributes of the assemblage in an integrated way to measure biotic health. A stream with good biotic health is " ...a balanced, integrated, adaptive system having the full range of elements and processes that are expected in the region's natural environment..." (Karr and Chu 1999). The approach designed by Plafkin et al. (1989) and adapted for use in the State of Montana has been defined as "... an array of measures or metrics that individually provide information on diverse biological attributes, and when integrated, provide an overall indication of biological condition." (Barbour et al. 1995). Community attributes that can contribute meaningfully to interpretation of benthic data include assemblage structure, sensitivity of community members to stress or pollution, and functional traits. Each metric component contributes an independent measure of the biotic integrity of a stream site; combining the components into a total score reduces variance and increases precision of the assessment (Fore et al. 1995). Effectiveness of the integrated metrics depends on the applicability of the underlying model, which rests on a foundation of three essential elements (Bollman 1998). The first of these is an appropriate stratification or classification of stream sites, typically, by ecoregion. Second, metrics must be selected based upon their ability to accurately express biological condition. Third, an adequate assessment of habitat conditions at each site to be studied is needed to assist in the interpretation of metric outcomes.

Implicit in the multimetric method and its associated habitat assessment is an assumption of correlative relationships between habitat parameters and the biotic metrics, in the absence of water quality impairment. These relationships may vary regionally, requiring an examination of habitat assessment elements and biotic metrics and a test of the presumed relationship between them. Bollman (1998) has recently studied the assemblages of the Montana Valleys and Foothill Prairies ecoregion, and has recommended a battery of metrics applicable to the montane ecoregions of western Montana. This metric battery has been shown to be sensitive to impairment, related to habitat assessment parameters, and consistent over replicated samples.

Habitat assessment enhances the interpretation of biological data (Barbour and Stribling 1991), because there is generally a direct response of the biological community to habitat degradation in the absence of water quality impairment. If biotic health appears more damaged than the habitat quality would predict, water pollution by metals, other toxicants, high water temperatures, or high levels of organic and/or nutrient pollution might be suspected. On the other hand, an "artificial" elevation of biotic condition in the presence of habitat degradation may be due to the paradoxical effect of mild nutrient or organic enrichment in an oligotrophic setting.

METHODS

Aquatic invertebrates were sampled by Montana DEQ personnel from June 18-26, 2001. Twelve sites on five streams were sampled. Site locations and sampling dates are indicated in Table 1. The sampling method employed was that recommended in the Montana Department of Environmental Quality (DEQ) Standard Operating Procedures for Aquatic Macroinvertebrate Sampling (Bukantis 1998). In addition to aquatic invertebrate sample collection, habitat quality was visually evaluated at each site and reported by means of the habitat assessment protocols recommended by Bukantis (1998).

Evaluated habitat features include instream conditions, larger-scale channel conditions including flow status, streambank condition, and extent of the riparian zone. Scores were assigned in the field to each habitat measure, and these scores were totaled and compared to the maximum possible score to give an overall assessment of habitat.

Aquatic invertebrate samples and associated habitat data were delivered to Rhithron Biological Associates, Missoula, Montana, for laboratory and data analyses. In the laboratory, the Montana DEQ-recommended sorting method was used to obtain subsamples of at least 300 organisms from each sample, when possible. Organisms were identified to the lowest possible taxonomic levels consistent with Montana DEQ protocols.

To assess aquatic invertebrate communities in this study, a multimetric index developed in previous work for streams of western Montana ecoregions (Bollman 1998) was used. Multimetric indices result in a single numeric score, which integrates the values of several individual indicators of biologic health. Each metric used in this index was tested for its response or sensitivity to varying degrees of human influence. Correlations have been demonstrated between the metrics and various symptoms of human-caused impairment as expressed in water quality parameters or instream, streambank and stream reach morphologic features. Metrics were screened to minimize variability over natural environmental gradients, such as site elevation or sampling season, which might confound interpretation of results (Bollman 1998). The multimetric index used in this report incorporates multiple attributes of the sampled assemblage into an integrated score that accurately describes the benthic community of each site in terms of its biologic integrity. In addition to the metrics comprising the index, other metrics, which have been shown to be applicable to biomonitoring in other regions (Kleindl 1995, Patterson 1996, Rossano 1995) were used for descriptive interpretation of results. These metrics include the number of "clinger" taxa, long-lived taxa richness, the percent of predatory organisms, and others. They are not included in the integrated bioassessment score, however, since their performance in western Montana ecoregions is unknown. However, the relationship of these metrics to habitat conditions is intuitive and reasonable.

The six metrics comprising the bioassessment index used in this study were selected because both individually and as an integrated metric battery, they are robust at distinguishing impaired sites from relatively unimpaired sites (Bollman 1998). In addition, they are relevant to the kinds of impacts that are present in the Blackfoot River drainage. They have been demonstrated to be more variable with anthropogenic disturbance than with natural environmental gradients (Bollman 1998). Each of the six metrics developed and tested for western Montana ecoregions is described below.

Table 1. Sampling sites and dates. Twelve sites on five streams in the Blackfoot River watershed. Sites are listed from upstream to downstream.

Site designation	Waterbody	Sampling Date	GPS Location Lat. Long.
Blkft1	Blackfoot River	6/21/01	47°00'39"N 112°27'17"W
Sandbar1	Sandbar Creek	6/18/01	47°00'27"N 112°23'08"W
Sandbar2	Sandbar Creek	6/18/01	46°59'51"N 112°23'58"W
Willow 1	Willow Creek	6/19/01	46°59'09"N 112°23'21"W
Willow 2	Willow Creek	6/21/01	47°00'31"N 112°27'28"W
Blkft2	Blackfoot River	6/21/01	46°58'30"N 112°32'05"W
Poor1	Poorman Creek	6/26/01	46°54'00"N 112°30'27"W
Poor2	Poorman Creek	6/26/01	46°52'23"N 112°32'57"W
Poor3	Poorman Creek	6/26/01	46°52'45"N 112°39'15"W
Arrastra1	Arrastra Creek	6/21/01	46°50'15"N 112°53'09"W
Arrastra2	Arrastra Creek	6/21/01	46°56'45"N 112°54'14"W
Blkft3	Blackfoot River	6/26/01	46°55'20"N 113°00'75"W

1. **Ephemeroptera (mayfly) taxa richness.** The number of mayfly taxa declines as water quality diminishes. Impairments to water quality which have been demonstrated to adversely affect the ability of mayflies to flourish include elevated water temperatures, heavy metal contamination, increased turbidity, low or high pH, elevated specific conductance and toxic chemicals. Few mayfly species are able to tolerate certain disturbances to instream habitat, such as excessive sediment deposition.

2. **Plecoptera (stonefly) taxa richness.** Stoneflies are particularly susceptible to impairments that affect a stream on a reach-level scale, such as loss of riparian canopy, streambank instability, channelization, and alteration of morphological features such as pool frequency and function, riffle development and sinuosity. Just as all benthic organisms, they are also susceptible to smaller scale habitat loss, such as by sediment deposition, loss of interstitial spaces between substrate particles, or unstable substrate.

3. **Trichoptera (caddisfly) taxa richness.** Caddisfly taxa richness has been shown to decline when sediment deposition affects their habitat. In addition, the presence of certain case-building caddisflies can indicate good retention of woody debris and lack of scouring flow conditions.

4. **Number of sensitive taxa.** Sensitive taxa are generally the first to disappear as anthropogenic disturbances increase. The list of sensitive taxa used here includes organisms sensitive to a wide range of disturbances, including warmer water temperatures, organic or nutrient pollution, toxic pollution, sediment deposition, substrate instability and others. Unimpaired streams of western Montana typically support at least four sensitive taxa (Bollman 1998).

5. **Percent filter feeders.** Filter-feeding organisms are a diverse group; they capture small particles of organic matter, or organically enriched sediment material, from the water column by means of a variety of adaptations, such as silken nets or hairy appendages. In forested montane streams, filterers are expected to occur in insignificant numbers. Their abundance increases when canopy cover is lost and when water temperatures increase and the accompanying growth of filamentous algae occurs. Some filtering organisms, specifically the Arctopsychid caddisflies (*Arctopsyche* spp. and *Parapsyche* sp.) build silken nets with large mesh sizes that capture small organisms such as chironomids and early-instar mayflies. Here they are considered predators, and, in this study, their abundance does not contribute to the percent filter feeders metric.

6. **Percent tolerant taxa.** Tolerant taxa are ubiquitous in stream sites, but when disturbance increases, their abundance increases proportionately. The list of taxa used here includes organisms tolerant of a wide range of disturbances, including warmer water temperatures, organic or nutrient pollution, toxic pollution, sediment deposition, substrate instability and others.

Scoring criteria for each of the six metrics are presented in Table 2. Metrics differ in their possible value ranges as well as in the direction the values move as biological conditions change. For example, Ephemeroptera richness values may range from zero to ten taxa or higher. Larger values generally indicate favorable biotic conditions. On the other hand, the percent filterers metric may range from 0% to 100%; in this case, larger values are negative indicators of biotic health. To facilitate scoring, therefore, metric values were transformed into a single scale. The range of each metric has been divided into four parts and assigned a point score between zero and three. A score of three indicates a metric value similar to one characteristic of a non-impaired condition. A score of zero indicates strong deviation from non-impaired condition and suggests severe degradation of biotic health. Scores for each metric were summed to give an overall score, the total bioassessment score, for each site in each sampling event. These scores were expressed as the percent of the maximum possible score, which is 18 for this metric battery.

Table 2. Metrics and scoring criteria for bioassessment of streams of western Montana ecoregions (Bollman 1998).

	Score			
metric	**3**	**2**	**1**	**0**
Ephemeroptera taxa richness	> 5	5 - 4	3 – 2	< 2
Plecoptera taxa richness	> 3	3 - 2	1	0
Trichoptera taxa richness	> 4	4 - 3	2	< 2
Sensitive taxa richness	> 3	3 - 2	1	0
Percent filterers	0 – 5	5.01 - 10	10.01 – 25	> 25
Percent tolerant taxa	0 – 5	5.01 - 10	10.01 – 35	> 35

The total bioassessment score for each site was expressed in terms of use-support. Criteria for use-support designations were developed by Montana DEQ and are presented in Table 3a. Scores were also translated into impairment classifications according to criteria outlined in Table 3a.

In this report, certain other metrics were used as descriptors of the benthic community response to habitat or water quality but were not incorporated into the bioassessment metric battery, either because they have not yet been tested for reliability in streams of western Montana, or because results of such testing did not show them to be robust at distinguishing impairment, or because they did not meet other requirements for inclusion in the metric battery. These metrics and their use in predicting the causes of impairment or in describing its effects on the biotic community are described below.

- The modified biotic index. This metric is an adaptation of the Hilsenhoff Biotic Index (HBI, Hilsenhoff 1987), which was originally designed to indicate organic enrichment of waters. Values of this metric are lowest in least impacted conditions. Taxa tolerant to saprobic conditions are also generally tolerant of warm water, fine sediment and heavy filamentous algae growth (Bollman, unpublished data). Loss of canopy cover is often a contributor to higher biotic index values. The taxa values used in this report are modified to reflect habitat and water quality conditions in Montana (Bukantis 1998). Ordination studies of the benthic fauna of Montana's foothill prairie streams showed that there is a correlation between modified biotic index values and water temperature, substrate embeddedness, and fine sediment (Bollman 1998). In a study of reference streams, the average value of the modified biotic index in least-impaired streams of western Montana was 2.5 (Wisseman 1992).
- Taxa richness. This metric is a simple count of the number of unique taxa present in a sample. Average taxa richness in samples from reference streams in western Montana was 28 (Wisseman 1992). Taxa richness is an expression of biodiversity, and generally decreases with degraded habitat or diminished water quality. However, taxa richness may show a paradoxical increase when mild nutrient enrichment occurs in previously oligotrophic waters, so this metric must be interpreted with caution.
- Percent predators. Aquatic invertebrate predators depend on a reliable source of invertebrate prey, and their abundance provides a measure of the trophic

complexity supported by a site. Less disturbed sites have more plentiful habitat niches to support diverse prey species, which in turn support abundant predator species.

- Number of "clinger" taxa. So-called "clinger" taxa have physical adaptations that allow them to cling to smooth substrates in rapidly flowing water. Aquatic invertebrate "clingers" are sensitive to fine sediments that fill interstices between substrate particles and eliminate habitat complexity. Animals that occupy the hyporheic zones are included in this group of taxa. Expected "clinger" taxa richness in unimpaired streams of western Montana is at least 14 (Bollman, unpublished data).
- Number of long-lived taxa. Long-lived or semivoltine taxa require more than a year to completely develop, and their numbers decline when habitat and/or water quality conditions are unstable. They may completely disappear if channels are dewatered or if there are periodic water temperature elevations or other interruptions to their life cycles. Western Montana streams with stable habitat conditions are expected to support six or more long-lived taxa (Bollman, unpublished data).

Table 3a. Criteria for the assignment of use-support classifications / standards violation thresholds (Bukantis, 1997).

% Comparability to reference	Use support
>75	Full support--standards not violated
25-75	Partial support--moderate impairment--standards violated
<25	Non-support--severe impairment--standards violated

Table 3b. Criteria for the assignment of impairment classifications (Plafkin et al. 1989).

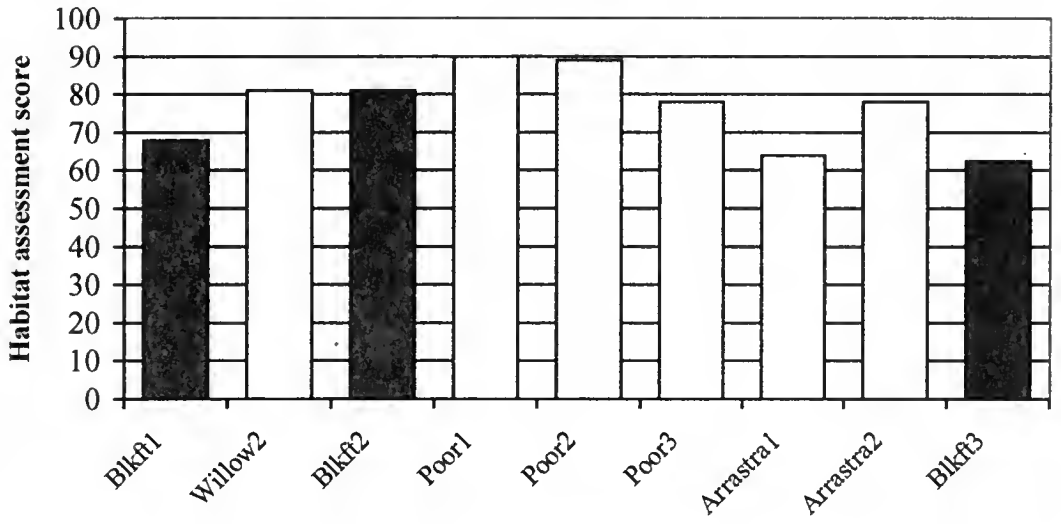
% Comparability to reference	Classification
> 83	nonimpaired
54-79	slightly impaired
21-50	moderately impaired
<17	severely impaired

RESULTS

Habitat assessment

Figure 1 compares habitat assessment results for the 9 sites for which data was available. Table 4 itemizes the evaluated habitat parameters and shows the assigned scores for each.

Figure 1. Total habitat assessment scores for sites in the Blackfoot River watershed, June 2001. Sites are listed from upstream to downstream. Bars representing Blackfoot River sites are darkly shaded.



Four of the 9 sites evaluated were judged to have optimal habitat conditions; other sites received sub-optimal scores. In general, benthic substrate diversity was less than expected at all sites, regardless of the overall habitat score.

At the Blackfoot River site above Willow Creek (Blkft1), streambanks were perceived to be moderately unstable, with sub-optimal vegetative protection. Instream features, such as benthic substrate diversity, embeddedness, and sediment deposition were rated sub-optimal. On Willow Creek, overall habitat conditions at the evaluated lower site (Willow2) were optimal, although instream features were judged sub-optimal; substrate particle sizes were less diverse than expected, and they were perceived to be 25-50% embedded. Small areas of streambank erosion or instability were also appraised.

Generally optimal habitat conditions were encountered at the Blackfoot River site below Willow Creek (Blkft2), although substrate diversity was judged to be limited and deposition of fine sediments affected up to 30% of the stream channel. Streambanks were perceived to be moderately stable, and the riparian zone width was abbreviated on one side of the channel. On Poorman Creek, the two upstream sites received optimal overall habitat scores. At the upper site (Poor1), however, benthic substrate diversity was judged marginal. Logs tossed into the channel to facilitate foot crossing were an added instream feature. At the middle Poorman Creek site (Poor2) the presence of a road crossing was perceived to affect the channel only minimally. Some fine sediment deposition was noted at the site. A sub-optimal total score at the downstream Poorman Creek site (Poor3) was

Table 4. Stream and riparian habitat assessment: Streams of the Blackfoot River watershed. June 2001. No assessment was provided for Sandbar Creek or for the upper site on Willow Creek.

Max. possible score	Parameter	Site designation								
		Blkft1	Willow 2	Blkft2	Poor1	Poor2	Poor3	Arrastra 1	Arrastra 2	Blkft3
10	Riffle development	9	8	10	10	10	9	10	7	3
10	Benthic substrate	8	7	8	4	7	6	7	4	9
20	Embeddedness	15	14	16	17	14	15	9	15	17
20	Channel alteration	11	19	17	17	19	15	15	18	18
20	Sediment deposition	12	16	14	20	15	10	9	6	6
20	Channel flow status	11	18	15	20	20	20	14	18	14
20	Bank stability r / l	5 / 6	6 / 6	8 / 10	9 / 9	9 / 9	8 / 6	6 / 6	10 / 8	6 / 0
20	Bank vegetation r / l	7 / 7	9 / 8	6 / 9	9 / 9	10 / 10	8 / 8	7 / 7	10 / 9	6 / 2
20	Vegetated zone r / l	9 / 9	9 / 9	7 / 9	10 / 10	10 / 10	10 / 10	5 / 7	10 / 10	10 / 9
160	Total	109	129	129	144	143	125	102	125	100
	Percent of maximum	**68**	**81**	**81**	**90**	**89**	**78**	**64**	**78**	**62.5**
	CONDITION*	**SUB**	**OPT**	**OPT**	**OPT**	**OPT**	**SUB**	**SUB**	**SUB**	**SUB**

*Condition categories: Optimal (OPT) > 80% of maximum score; Sub-optimal (SUB) ; 75 - 56%; Marginal (MARG) 49 - 29%; Poor <23%. Adapted from Plafkin et al. 1988.

due to the condition of instream features as well as streambank features. Fine sediment deposition apparently limited instream habitats, reduced benthic substrate diversity, and increased embeddedness.

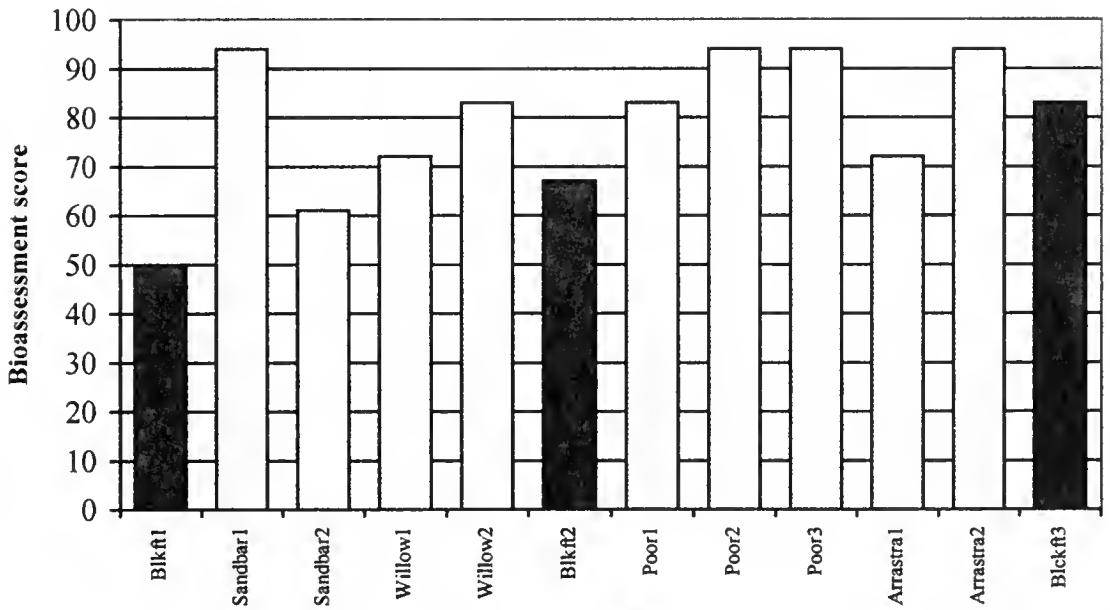
Both sites on Arrastra Creek received sub-optimal total habitat scores. At the upstream site (Arrastra1), sediment deposition and substrate embeddedness were perceived to be moderately severe; in addition, streambanks were judged only moderately stable, and the riparian zone width was less than expected. At the downstream site, fine gravel dominated the benthic substrate, limiting its diversity. Heavy silt deposition was noted in both pools and riffles.

The most downstream Blackfoot River site (Blkft3) was located at the Aunt Molly fishing access. There, sub-optimal overall habitat was perceived, with moderately severe fine sediment deposition and limited riffle development noted. Poor streambank stability was perceived on one side of the channel, where vegetative protection was extensively disrupted.

Bioassessment

Figure 2 summarizes bioassessment scores for aquatic invertebrate communities at the twelve sites in this study. Table 5 itemizes each contributing metric and shows individual metric scores for each site. Tables 3a and 3b show criteria for impairment classifications and use-support categories recommended by Montana DEQ.

Figure 2. Total bioassessment scores for twelve sites in the Blackfoot River watershed, June 2001. Sites are described in Table 1.



Four of the sites in this study yielded samples with fewer than the minimum number of organisms to provide reliable bioassessment results. Whether this was due to depauperate communities at the sites or to sampling bias is not clear from the data. Thus, the accuracy of results and conclusions pertinent to sites Blkft1, Sandbar1 and Sandbar2,

Table 5. Metric values, scores, and bioassessments for sites in the Blackfoot River watershed, June 2001. Sites are described in Table 1. Assessment classifications and use support designations in parentheses are tentative, since they are based on samples with inadequate numbers of organisms.

	SITES											
	Blkft1	Sandbar 1	Sandbar 2	Willow 1	Willow 2	Blkft2	Poor1	Poor2	Poor3	Arrastra 1	Arrastra2	Blkft3
METRICS	**METRIC VALUES**											
Ephemeroptera richness	0	6	0	5	7	7	8	6	9	6	8	10
Plecoptera richness	2	6	5	4	3	1	3	3	3	1	4	5
Trichoptera richness	2	3	0	5	6	5	3	10	6	1	4	6
Number of sensitive taxa	2	5	3	3	4	1	3	10	9	4	4	3
Percent filterers	0	1	0	16	1	2	0	1	0	0	0	6
Percent tolerant taxa	16	2	0	9	18	2	4	3	4	0	4	6
	METRIC SCORES											
Ephemeroptera richness	0	3	0	2	3	3	3	3	3	3	3	3
Plecoptera richness	2	3	3	3	2	1	2	2	2	1	3	3
Trichoptera richness	1	2	0	3	3	3	2	2	3	0	2	3
Number of sensitive taxa	2	3	2	2	3	1	2	2	3	3	3	2
Percent filterers	3	3	3	1	3	3	3	2	3	3	3	2
Percent tolerant taxa	1	3	3	2	1	3	3	2	3	3	3	2
TOTAL SCORE (max.=18)	9	17	11	13	15	12	15	17	17	13	17	15
PERCENT OF MAX.	**(50)**	**(94)**	**(61)**	**72**	**83**	**67**	**83**	**94**	**94**	**(72)**	**94**	**83**
Impairment classification*	**(MOD)**	**(NON)**	**(SLI)**	**SLI**	**NON**	**SLI**	**NON**	**NON**	**NON**	**(SLI)**	**NON**	**NON**
USE SUPPORT †	**(PART)**	**(FULL)**	**(PART)**	**PART**	**FULL**	**PART**	**FULL**	**FULL**	**FULL**	**(PART)**	**FULL**	**FULL**

* Classifications: (NON) non-impaired, (SLI) slightly impaired, (MOD) moderately impaired, (SEV) severely impaired. See Table 3a.

† Use support designations: See Table 3b.

and Arrastra1 should be regarded as tentative. The uncertainty of scores and classifications for these sites is noted in Table 5. Bioassessment scores derived from the method used here, and in spite of low abundance of organisms in the 4 samples mentioned above, suggest that 7 of the 12 sites studied achieve full support of designated uses and are essentially non-impaired.

Interestingly, the graph illustrates the steady improvement in bioassessment scores for Blackfoot River sites from upstream to downstream locations. Site Blkft1, above the confluence with Willow Creek, was appraised as moderately impaired and only partly supports its designated uses. The site yielded no Ephemeroptera taxa, and had fewer Plecoptera and Trichoptera taxa than expected. In addition, tolerant taxa comprised a fairly large proportion of the assemblage. However, the sample taken at this site did not have sufficient numbers of organisms to provide a reliable result. The intermediate Blackfoot River site, Blkft2, only partly supports uses, but impairment appears to be slight. The sample taken at the site contained fewer Plecoptera taxa than expected, and only a single sensitive taxon was present. At the Aunt Molly fishing access, Blkft3, the river fully supports designated uses and is essentially non-impaired.

Neither sample taken from Sandbar Creek contained enough animals to make a valid bioassessment. However, the assemblage taken at the upstream site (Sandbar1) contained 25 taxa, among which were enough Ephemeroptera, Plecoptera, and sensitive taxa to suggest that biotic health is essentially unimpaired by human disturbances. At the lower site (Sandbar2), conclusions are more speculative, since only 35 animals were present in the sample. No Ephemeroptera or Trichoptera taxa were taken there.

The upper site on Willow Creek (Willow1) partly supports uses and exhibits slight impairment evident in the larger proportions of tolerant organisms and filter-feeders than expected. While the sample taken at the downstream site (Willow2) had a low abundance of organisms, the Ephemeroptera and Trichoptera taxa richnesses were as high as expected for a montane stream unimpaired by human disturbance. The proportion of tolerant taxa among the 277 organisms present in the sample was higher than expected, however.

Bioassessment scores suggest full use support and unimpaired biotic health at all three sites visited on Poorman Creek. While the abundance of organisms collected at the downstream site (Poor3) was somewhat low, the performance of the richness metrics suggest that numbers were adequate for bioassessment purposes.

No Trichoptera taxa and only a single Plecoptera taxon were collected at the upstream site on Arrastra Creek (Arrastra1); this finding may be evidence of impairment, but it may also be evidence of sampling error, since only 210 organisms in total were taken in the sample. The conclusion of slight impairment and partial support of uses is uncertain. At the downstream site (Arrastra2), the benthic assemblage was characteristic of a montane stream with minimal human disturbance.

The lowermost site on the Blackfoot River (Blkft3) visited for this study was rich in Ephemeroptera, Plecoptera, and Trichoptera taxa, and although more sensitive taxa would be expected to occur and tolerant taxa and filter-feeders were more abundant than expected, scores suggest that the site fully supports designated uses and is essentially unimpaired.

Aquatic invertebrate communities

Meaningful analysis of the benthic assemblage collected at the uppermost Blackfoot River site (Blkft1) is hampered by the low abundance of organisms in the sample. The paucity of organisms may reflect the conditions at the site but may also be due to problems associated with sampling, including the possibility of inadequate sampling effort for conditions. If the sample accuracy represents site conditions, the low abundance may be due to torrential flow conditions, lack of suitable instream habitat, or to severe water quality degradation. None of these seems likely; neither unusual flow conditions nor obvious habitat problems were noted by field personnel. And although another bellwether of water quality problems was also present, namely, a dearth of mayflies, two sensitive taxa in other orders were present in the sample. These were the stonefly *Doroneuria* sp. and the dipteran *Rhabdomastix* sp. Six taxa, or 40% of the total number of taxa collected, were "clingers", suggesting that substrates unimpaired by fine sediment deposition were available.

Low abundance characterized both samples taken on Sandbar Creek, rendering an interpretation suspect. Once again, sampling problems may have contributed to the inadequate capture of benthic organisms. At the upstream site (Sandbar1), 25 taxa were represented in a sample of only 81 total organisms, suggesting a diverse and rich community. No fewer than 5 sensitive organisms were present in the sample, including the mayfly *Drunella spinifera* and the stoneflies *Visoka cataractae* and *Despaxia augusta*. Cold-stenotherms are amply represented, indicating that water temperature was within expected ranges for a montane stream. The presence of 12 "clinger" taxa obviates the possibility of extensive fine sediment impacts. At the downstream site (Sandbar2), the inadequacy of the sample was even more profound; only 35 animals were present. Still, cold-stenotherms were present, including the nemourid stonefly *Zapada frigida* and the midge *Diamesa* sp., suggesting that there was no thermal impairment of this waterway.

At the upstream site on Willow Creek (Willow1), there is subtle evidence of slight water quality impairment. Mayfly taxa richness is slightly lower than expected, and no sensitive mayfly taxa were collected. Only 2 sensitive taxa occurred in the sample, including the caddisfly *Eocosmoecus schmidi*, and the midge *Cricotopus nostococladius*, but neither taxon was present in abundance. Nine percent of sampled animals were tolerant, and nearly 42% of animals collected were midges. The abundance of filter-feeders (16% of the assemblage) suggests that suspended organic material was plentiful. Clean substrates were apparently available, since 16 "clinger" taxa occurred at the site. At the lower site (Willow2), tolerant taxa were also abundant, comprising 18% of sampled animals. This finding suggests mild water quality impairment at this site as well, although the performance of the other bioassessment metrics was good enough to result in an overall score indicating unimpaired biotic health. Dewatering or other catastrophic insults apparently do not affect the benthos of Willow Creek, since long-lived taxa were plentiful at both sites.

Below Willow Creek, the intermediate Blackfoot River site (Blkft2) supported an assemblage that was somewhat less diverse than expected; only 22 taxa were collected in the sample. Only a single stonefly taxon, the chloroperlid *Sweltsa* sp. was present in the sample; in addition, predators were poorly represented among the functional groups. Only two predatory taxa were collected, including a single early instar of *Rhyacophila* sp. These findings suggest that monotonous habitat conditions may limit the potential of the

benthic community at this site. Low stonefly taxa richness may indicate habitat disturbance at a reach-scale. Small-scale habitat features appear to be relatively intact, since 13 "clinger" taxa were present in the sample. The modified biotic index value (2.14) suggests that water quality was good, as does the capture of 7 mayfly taxa.

All three sites on Poorman Creek exhibited benthic assemblages characteristic of montane streams essentially unimpaired by human disturbances. Taxa richness was high at all sites, and sensitive taxa were amply represented; sites Poor2 and Poor3 had 10 and 9 sensitive taxa in samples, respectively. Relatively high numbers of the turbellarian *Polycelis coronata* suggest that groundwater contributes to flow at all sites. Low modified biotic index values (3.35 at Poor1, 2.36 at Poor2, and 3.51 at Poor3) calculated for the three assemblages suggest good water quality. "Clinger" taxa richness was high at all sites, indicating that clean, hard substrate surfaces were extensively available.

The upstream site on Arrastra Creek (Arrastra1) yielded a sample with low abundance of organisms and low taxa richness, raising the concern that sample effort may have inadequately represented the community at this site. Alternatively, low abundance of organisms and low diversity may characterize the site, but the two possibilities cannot be distinguished using the data at hand. Six mayfly taxa and 4 sensitive taxa were present, however, suggesting that, in either case, water quality was unimpaired. Stonefly and caddisfly taxa were essentially absent from the sample, suggesting either that habitat was extensively disturbed or that no hypotheses concerning habitat ought to be made. The downstream site on Arrastra Creek (Arrastra2) supported a rich assemblage suggesting that diverse habitats were available. Good water quality is also implied by the low modified biotic index value (3.71) calculated for the assemblage, by the rich mayfly fauna, and by the 4 sensitive taxa present in the sample.

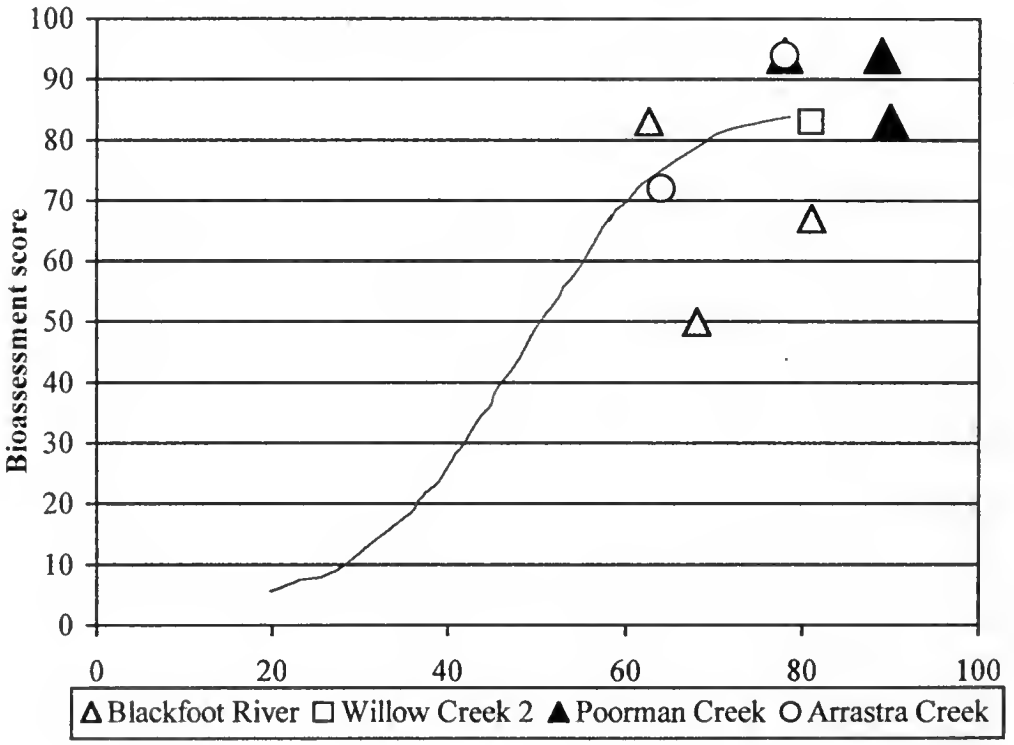
Among the 3 sites visited on the Blackfoot River, the most downstream site at the Aunt Molly fishing access (Blkft3) supported the richest fauna; 30 taxa were collected. This finding, along with the presence of 6 predatory fauna, suggests that instream habitats were diverse and available. Fifteen "clinger" taxa occupied clean, hard substrates, implying that fine sediments did not greatly impact the benthic assemblage. The modified biotic index value (1.83) was the lowest of any site in the study, suggesting that water quality was not degraded by pollutants or thermal impacts.

CONCLUSIONS

- Blackfoot River sites appear to improve in water quality as well as habitat features from the upstream site (Blkft1) to the downstream site (Blkft3), though low abundance of organisms, possibly attributable to sampling procedures, makes interpretations difficult.
- Low abundance of organisms in samples taken at Sandbar Creek sites makes assessment speculative.
- Willow Creek may have slight water quality impairment at the upper site (Willow1) though the downstream site (Willow2) appears to be characteristic of an unimpaired montane system.
- Poorman Creek supported assemblages that suggest good water quality and intact habitats. All functional components of a near-pristine benthic community are well represented.

- Low abundance of organisms in the sample taken at the upstream site on Arrastra Creek (Arrastra1) makes assessment speculative. At the downstream site (Arrastra2), benthic invertebrates suggest good habitat conditions as well as good water quality.
- Figure 3 graphs the relationship between habitat assessment scores and bioassesment scores for sites sampled in this study. The red curve in the center of the graph represents the hypothetical relationship between habitat quality and biotic health when habitat degradation is the sole source of impairment to benthic assemblage health. (Barbour and Stribling 1991). Symbols which fall below the line indicate bioassessment scores much lower than the perceived habitat quality would be expected to support. This suggests that water quality perturbations or flow conditions impair biotic health in the presence of generally good habitat.

Figure 3. The relationship of habitat assessment scores and bioassessment scores for sites in the Blackfoot River watershed for which habitat data was available. The red curve represents the hypothetical relationship between habitat scores and bioassessment scores if habitat quality solely determined biotic health.



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APPENDIX

Taxonomic data and summaries

The Blackfoot River watershed

June, 2001

Aquatic Invertebrate Taxonomic Data

Site Name: Blackfoot River
Site ID: BlckftR-02 6/21/01

Approx. percent of sample used: 57

Taxon	Quantity	Percent	HBI	FFG
Nematoda	5	1.57	5	PA
Total Misc. Taxa	**5**	**1.57**		
Acentrella turbida	1	0.31	4	CG
Baetis tricaudatus	3	0.94	6	CG
Drunella coloradensis	12	3.76	0	CG
Drunella grandis	3	0.94	2	CG
Ephemerella inermis	2	0.63	1	CG
Cinygmula sp.	46	14.42	4	SC
Epeorus longimanus	177	55.49	1	SC
Total Ephemeroptera	**244**	**76.49**		
Sweltsa sp.	16	5.02	1	PR
Total Plecoptera	**16**	**5.02**		
Brachycentrus americanus	1	0.31	1	OM
Micrasema sp.	5	1.57	1	MH
Hydropsyche sp.	5	1.57	4	CF
Lepidostoma sp.-sand case larvae	1	0.31	1	SH
Rhyacophila-early instar	1	0.31	0	PR
Total Trichoptera	**13**	**4.08**		
Narpus sp.	1	0.31	4	CG
Optioservus sp.	2	0.63	4	SC
Total Coleoptera	**3**	**0.94**		
Simulium sp.	1	0.31	6	CF
Rhabdomastix sp.	1	0.31	3	UN
Total Diptera	**2**	**0.63**		
Eukiefferiella Devonica Gr.	1	0.31	4	OM
Orthocladius sp.	3	0.94	6	CG
Pagastia sp.	2	0.63	1	CG
Polypedilum sp.	30	9.40	6	OM
Total Chironomidae	**36**	**11.29**		
Grand Total	**319**	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: Blackfoot River **Site ID: BlckftR-02 6/21/01**

TOTAL ABUNDANCE	319
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	273
TOTAL NUMBER OF TAXA	22
Number EPT taxa	13

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	1	5	1.57
Odonata	0	0	0.00
Ephemeroptera	7	244	76.49
Plecoptera	1	16	5.02
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	5	13	4.08
Lepidoptera	0	0	0.00
Coleoptera	2	3	0.94
Diptera	2	2	0.63
Chironomidae	4	36	11.29

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	7.58

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	2	17	5.33
Parasite	1	5	1.57
Collector-gatherer	8	27	8.46
Collector-filterer	2	6	1.88
Macrophyte-herbivore	1	5	1.57
Piercer-herbivore	0	0	0.00
Scraper	3	225	70.53
Shredder	1	1	0.31
Xylophage	0	0	0.00
Omnivore	3	32	10.03
Unknown	1	1	0.31

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	37.50
Scraper/(Scraper + C.filterer)	0.97
Shredder/Total organisms	0.00

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Epeorus longimanus	177	55.49
Cinygmula sp.	46	14.42
Polypedilum sp.	30	9.40
Sweltsa sp.	16	5.02
Drunella coloradensis	12	3.76
SUBTOTAL 5 DOMINANTS	281	88.09
Nematoda	5	1.57
Micrasema sp.	5	1.57
Hydropsyche sp.	5	1.57
Baetis tricaudatus	3	0.94
Drunella grandis	3	0.94
TOTAL DOMINANTS	299	93.73

SAPROBIC INDICES

Hilsenhoff Biotic Index	2.14

DIVERSITY MEASURES

Shannon H (loge)	1.31
Shannon H (log2)	1.89
Evenness	0.42
Simpson D	0.28

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	36	11.36
Univoltine	278	87.23
Semivoltine	5	1.41

	#TAXA	ABUNDANCE	PERCENT
Tolerant	2	5	1.57
Intolerant	1	1	0.31
Clinger	13	286	89.66

Aquatic Invertebrate Taxonomic Data

Site Name: Poorman Creek
Site ID: PoorC-01 6/26/01

Approx. percent of sample used: 100

Taxon	Quantity	Percent	HBI	FFG
Polycelis coronata	16	5.26	4	CG
Eiseniella tetraedra	8	2.63	8	CG
Acari	1	0.33	5	PA
Total Misc. Taxa	**25**	**8.22**		
Baetis bicaudatus	2	0.66	4	CG
Baetis tricaudatus	3	0.99	6	CG
Drunella coloradensis	13	4.28	0	CG
Ephemerella inermis	1	0.33	1	CG
Serratella tibialis	1	0.33	2	CG
Cinygmula sp.	3	0.99	4	SC
Epeorus longimanus	2	0.66	1	SC
Rhithrogena sp.	1	0.33	0	SC
Total Ephemeroptera	**26**	**8.55**		
Chloroperlidae - early instars	1	0.33	1	PR
Zapada cinctipes	1	0.33	2	SH
Kogotus sp.	1	0.33	2	PR
Total Plecoptera	**3**	**0.99**		
Micrasema sp.	31	10.20	1	MH
Rhyacophila Brunnea Gr.	6	1.97	1	PR
Rhyacophila narvae	9	2.96	1	PR
Total Trichoptera	**46**	**15.13**		
Heterlimnius sp.	24	7.89	4	CG
Narpus sp.	1	0.33	4	CG
Optioservus sp.	7	2.30	4	SC
Total Coleoptera	**32**	**10.53**		
Chelifera sp.	1	0.33	6	PR
Glutops sp.	14	4.61	3	PR
Antocha sp.	1	0.33	3	CG
Total Diptera	**16**	**5.26**		
Eukiefferiella Devonica Gr.	132	43.42	4	OM
Eukiefferiella Gracei Gr.	6	1.97	4	OM
Eukiefferiella Pseudomontana Gr.	1	0.33	8	OM
Orthocladius sp.	6	1.97	6	CG
Pagastia sp.	10	3.29	1	CG
Tvetenia sp.	1	0.33	5	CG
Total Chironomidae	**156**	**51.32**		
Grand Total	**304**	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: Poorman Creek **Site ID: PoorC-01 6/26/01**

TOTAL ABUNDANCE	304
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	75
TOTAL NUMBER OF TAXA	29
Number EPT taxa	14

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	3	25	8.22
Odonata	0	0	0.00
Ephemeroptera	8	26	8.55
Plecoptera	3	3	0.99
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	3	46	15.13
Lepidoptera	0	0	0.00
Coleoptera	3	32	10.53
Diptera	3	16	5.26
Chironomidae	6	156	51.32

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	0.48

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	6	32	10.53
Parasite	1	1	0.33
Collector-gatherer	13	87	28.62
Collector-filterer	0	0	0.00
Macrophyte-herbivore	1	31	10.20
Piercer-herbivore	0	0	0.00
Scraper	4	13	4.28
Shredder	1	1	0.33
Xylophage	0	0	0.00
Omnivore	3	139	45.72
Unknown	0	0	0.00

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	#DIV/0!
Scraper/(Scraper + C.filterer)	1.00
Shredder/Total organisms	0.00

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Eukiefferiella Devonica Gr.	132	43.42
Micrasema sp.	31	10.20
Heterlimnius sp.	24	7.89
Polycelis coronata	16	5.26
Glutops sp.	14	4.61
SUBTOTAL 5 DOMINANTS	217	71.38
Drunella coloradensis	13	4.28
Pagastia sp.	10	3.29
Rhyacophila narvae	9	2.96
Eiseniella tetraedra	8	2.63
Optioservus sp.	7	2.30
TOTAL DOMINANTS	264	86.84

SAPROBIC INDICES

Hilsenhoff Biotic Index	3.35

DIVERSITY MEASURES

Shannon H (loge)	1.88
Shannon H (log2)	2.72
Evenness	0.56
Simpson D	0.18

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	138	45.31
Univoltine	127	41.69
Semivoltine	40	12.99

	#TAXA	ABUNDANCE	PERCENT
Tolerant	3	11	3.62
Intolerant	2	15	4.93
Clinger	14	101	33.22

Aquatic Invertebrate Taxonomic Data

Site Name: Poorman Creek
Site ID: PoorC-02 6/26/01

Approx. percent of sample used: 37

Taxon	Quantity	Percent	HBI	FFG
Polycelis coronata	39	13.00	4	CG
Nematoda	1	0.33	5	PA
Sphaeriidae	1	0.33	8	CG
Total Misc. Taxa	**41**	**13.67**		
Baetis tricaudatus	10	3.33	6	CG
Caudatella hystrix	9	3.00	1	CG
Drunella coloradensis	14	4.67	0	CG
Drunella spinifera	1	0.33	0	PR
Ephemerella inermis	5	1.67	1	CG
Cinygmula sp.	16	5.33	4	SC
Total Ephemeroptera	**55**	**18.33**		
Sweltsa sp.	9	3.00	1	PR
Zapada columbiana	21	7.00	2	SH
Yoraperla sp.	28	9.33	1	SH
Total Plecoptera	**58**	**19.33**		
Parapsyche elsis	1	0.33	1	PR
Brachycentrus americanus	7	2.33	1	OM
Micrasema sp.	1	0.33	1	MH
Anagapetus sp.	46	15.33	0	SC
Ecclisomyia sp.	1	0.33	2	OM
Rhyacophila Betteni Gr.	7	2.33	1	PR
Rhyacophila Brunnea Gr.	12	4.00	1	PR
Rhyacophila narvae	1	0.33	1	PR
Rhyacophila verrula	5	1.67	0	MH
Oligophlebodes sp.	3	1.00	0	SC
Total Trichoptera	**84**	**28.00**		
Heterlimnius sp.	23	7.67	4	CG
Total Coleoptera	**23**	**7.67**		
Glutops sp.	1	0.33	3	PR
Prosimulium sp.	1	0.33	3	CF
Total Diptera	**2**	**0.67**		
Eukiefferiella sp.- early instar	4	1.33	8	OM
Eukiefferiella Devonica Gr.	3	1.00	4	OM
Micropsectra sp.	14	4.67	7	CG
Pagastia sp.	8	2.67	1	CG
Parametriocnemus sp.	1	0.33	5	CG
Rheotanytarsus sp.	3	1.00	6	CF
Tvetenia Bavarica Gr.	4	1.33	5	CG
Total Chironomidae	**37**	**12.33**		
Grand Total	**300**	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: Poorman Creek **Site ID: PoorC-02 6/26/01**

TOTAL ABUNDANCE	300
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	197
TOTAL NUMBER OF TAXA	32
Number EPT taxa	19

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	3	41	13.67
Odonata	0	0	0.00
Ephemeroptera	6	55	18.33
Plecoptera	3	58	19.33
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	10	84	28.00
Lepidoptera	0	0	0.00
Coleoptera	1	23	7.67
Diptera	2	2	0.67
Chironomidae	7	37	12.33

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	5.32

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	7	32	10.67
Parasite	1	1	0.33
Collector-gatherer	11	128	42.67
Collector-filterer	2	4	1.33
Macrophyte-herbivore	2	6	2.00
Piercer-herbivore	0	0	0.00
Scraper	3	65	21.67
Shredder	2	49	16.33
Xylophage	0	0	0.00
Omnivore	4	15	5.00
Unknown	0	0	0.00

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	16.25
Scraper/(Scraper + C.filterer)	0.94
Shredder/Total organisms	0.05

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Anagapetus sp.	46	15.33
Polycelis coronata	39	13.00
Yoraperla sp.	28	9.33
Heterlimnius sp.	23	7.67
Zapada columbiana	21	7.00
SUBTOTAL 5 DOMINANTS	157	52.33
Cinygmula sp.	16	5.33
Drunella coloradensis	14	4.67
Micropsectra sp.	14	4.67
Rhyacophila Brunnea Gr.	12	4.00
Baetis tricaudatus	10	3.33
TOTAL DOMINANTS	213	71.00

SAPROBIC INDICES

Hilsenhoff Biotic Index	2.36

DIVERSITY MEASURES

Shannon H (loge)	2.55
Shannon H (log2)	3.67
Evenness	0.73
Simpson D	0.07

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	75	25.08
Univoltine	181	60.25
Semivoltine	44	14.67

	#TAXA	ABUNDANCE	PERCENT
Tolerant	1	10	3.33
Intolerant	8	106	35.33
Clinger	18	181	60.33

Aquatic Invertebrate Taxonomic Data

Site Name: Poorman Creek
Site ID: PoorC-03 6/26/01

Approx. percent of sample used: 100

Taxon	Quantity	Percent	HBI	FFG
Polycelis coronata	21	7.61	4	CG
Haplotaxis gordiodes	2	0.72	11	CG
Enchytraeidae	1	0.36	4	CG
Eiseniella tetraedra	8	2.90	8	CG
Sphaeriidae	5	1.81	8	CG
Hydrobiidae	2	0.72	8	SC
Acari	3	1.09	5	PA
Total Misc. Taxa	**42**	**15.22**		
Baetis bicaudatus	1	0.36	4	CG
Diphetor hageni	3	1.09	5	CG
Drunella coloradensis	7	2.54	0	CG
Drunella spinifera	1	0.36	0	PR
Ephemerella inermis	1	0.36	1	CG
Cinygma sp.	10	3.62	2	SC
Cinygmula sp.	39	14.13	4	SC
Paraleptophlebia sp.	4	1.45	4	CG
Ameletus sp.	1	0.36	0	CG
Total Ephemeroptera	**67**	**24.28**		
Sweltsa sp.	10	3.62	1	PR
Zapada columbiana	2	0.72	2	SH
Yoraperla sp.	38	13.77	1	SH
Total Plecoptera	**50**	**18.12**		
Parapsyche elsis	2	0.72	1	PR
Anagapetus sp.	5	1.81	0	SC
Rhyacophila Betteni Gr.	2	0.72	1	PR
Rhyacophila blarina	8	2.90	1	PR
Rhyacophila narvae	1	0.36	1	PR
Oligophlebodes sp.	1	0.36	0	SC
Total Trichoptera	**19**	**6.88**		
Heterlimnius sp.	68	24.64	4	CG
Hydrophilidae - larvae	1	0.36	5	PR
Hydrobius	1	0.36	5	PR
Total Coleoptera	**70**	**25.36**		
Ptychoptera sp.	3	1.09	7	CG
Total Diptera	**3**	**1.09**		
Constempellina sp.	2	0.72	4	CG
Cricotopus nostococladius	6	2.17	3	PH
Eukiefferiella Pseudomontana Gr.	9	3.26	8	OM
Micropsectra sp.	2	0.72	7	CG
Parametriocnemus sp.	2	0.72	5	CG
Paratanytarsus sp.	1	0.36	6	UN
Polypedilum sp.	1	0.36	6	OM
Rheocricotopus sp.	1	0.36	6	OM
Tvetenia sp.	1	0.36	5	CG
Total Chironomidae	**25**	**9.06**		
Grand Total	**276**	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: Poorman Creek **Site ID: PoorC-03 6/26/01**

TOTAL ABUNDANCE	276
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	136
TOTAL NUMBER OF TAXA	38
Number EPT taxa	18

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	7	42	15.22
Odonata	0	0	0.00
Ephemeroptera	9	67	24.28
Plecoptera	3	50	18.12
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	6	19	6.88
Lepidoptera	0	0	0.00
Coleoptera	3	70	25.36
Diptera	1	3	1.09
Chironomidae	9	25	9.06

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	5.44

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	8	26	9.42
Parasite	1	3	1.09
Collector-gatherer	17	132	47.83
Collector-filterer	0	0	0.00
Macrophyte-herbivore	0	0	0.00
Piercer-herbivore	1	6	2.17
Scraper	5	57	20.65
Shredder	2	40	14.49
Xylophage	0	0	0.00
Omnivore	3	11	3.99
Unknown	1	1	0.36

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	#DIV/0!
Scraper/(Scraper + C.filterer)	1.00
Shredder/Total organisms	0.05

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Heterlimnius sp.	68	24.64
Cinygmula sp.	39	14.13
Yoraperla sp.	38	13.77
Polycelis coronata	21	7.61
Cinygma sp.	10	3.62
SUBTOTAL 5 DOMINANTS	176	63.77
Sweltsa sp.	10	3.62
Eukiefferiella Pseudomontana C	9	3.26
Eiseniella tetraedra	8	2.90
Rhyacophila blarina	8	2.90
Drunella coloradensis	7	2.54
TOTAL DOMINANTS	218	78.99

SAPROBIC INDICES

Hilsenhoff Biotic Index	3.51

DIVERSITY MEASURES

Shannon H (loge)	2.37
Shannon H (log2)	3.42
Evenness	0.65
Simpson D	0.10

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	46	16.58
Univoltine	150	54.44
Semivoltine	80	28.99

	#TAXA	ABUNDANCE	PERCENT
Tolerant	2	12	4.35
Intolerant	6	54	19.57
Clinger	13	183	66.30

Aquatic Invertebrate Taxonomic Data

Site Name: Arrastra Creek
Site ID: AraC-01 6/21/01

Approx. percent of sample used: 100

Taxon	Quantity	Percent	HBI	FFG
Enchytraeidae	3	1.43	4	CG
Total Misc. Taxa	**3**	**1.43**		
Baetis bicaudatus	5	2.38	4	CG
Drunella coloradensis	10	4.76	0	CG
Drunella doddsi	4	1.90	0	CG
Cinygmula sp.	68	32.38	4	SC
Epeorus longimanus	62	29.52	1	SC
Rhithrogena sp.	12	5.71	0	SC
Total Ephemeroptera	**161**	**76.67**		
Kogotus sp.	1	0.48	2	PR
Total Plecoptera	**1**	**0.48**		
Rhyacophila Alberta Gr.	1	0.48	0	PR
Total Trichoptera	**1**	**0.48**		
Dicranota sp.	3	1.43	3	PR
Total Diptera	**3**	**1.43**		
Brillia sp.	2	0.95	5	SH
Micropsectra sp.	26	12.38	7	CG
Tvetenia sp.	13	6.19	5	CG
Total Chironomidae	**41**	**19.52**		
Grand Total	**210**	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: Arrastra Creek **Site ID: AraC-01 6/21/01**

TOTAL ABUNDANCE	210
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	163
TOTAL NUMBER OF TAXA	13
Number EPT taxa	8

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	1	3	1.43
Odonata	0	0	0.00
Ephemeroptera	6	161	76.67
Plecoptera	1	1	0.48
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	1	1	0.48
Lepidoptera	0	0	0.00
Coleoptera	0	0	0.00
Diptera	1	3	1.43
Chironomidae	3	41	19.52

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	3.98

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	3	5	2.38
Parasite	0	0	0.00
Collector-gatherer	6	61	29.05
Collector-filterer	0	0	0.00
Macrophyte-herbivore	0	0	0.00
Piercer-herbivore	0	0	0.00
Scraper	3	142	67.62
Shredder	1	2	0.95
Xylophage	0	0	0.00
Omnivore	0	0	0.00
Unknown	0	0	0.00

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	#DIV/0!
Scraper/(Scraper + C.filterer)	1.00
Shredder/Total organisms	0.00

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Cinygmula sp.	68	32.38
Epeorus longimanus	62	29.52
Micropsectra sp.	26	12.38
Tvetenia sp.	13	6.19
Rhithrogena sp.	12	5.71
SUBTOTAL 5 DOMINANTS	181	86.19
Drunella coloradensis	10	4.76
Baetis bicaudatus	5	2.38
Drunella doddsi	4	1.90
Dicranota sp.	3	1.43
Enchytraeidae	3	1.43
TOTAL DOMINANTS	206	98.10

SAPROBIC INDICES

Hilsenhoff Biotic Index	3.02

DIVERSITY MEASURES

Shannon H (loge)	1.85
Shannon H (log2)	2.66
Evenness	0.72
Simpson D	0.21

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	35	16.43
Univoltine	175	83.33
Semivoltine	1	0.24

	#TAXA	ABUNDANCE	PERCENT
Tolerant	0	0	0.00
Intolerant	2	2	0.95
Clinger	7	158	75.24

Aquatic Invertebrate Taxonomic Data

Site Name: Arrastra Creek
Site ID: AraC-02 6/21/01

Approx. percent of sample used: 70

Taxon	Quantity	Percent	HBI	FFG
Polycelis coronata	1	0.32	4	CG
Nematoda	1	0.32	5	PA
Tubificidae - immature	1	0.32	9	CG
Eiseniella tetraedra	18	5.81	8	CG
Sphaeriidae	12	3.87	8	CG
Total Misc. Taxa	**33**	**10.65**		
Baetis tricaudatus	11	3.55	6	CG
Drunella coloradensis	1	0.32	0	CG
Drunella grandis	1	0.32	2	CG
Ephemerella inermis	4	1.29	1	CG
Cinygmula sp.	102	32.90	4	SC
Epeorus longimanus	25	8.06	1	SC
Rhithrogena sp.	1	0.32	0	SC
Paraleptophlebia sp.	2	0.65	4	CG
Total Ephemeroptera	**147**	**47.42**		
Sweltsa sp.	4	1.29	1	PR
Zapada Oregonensis Gr.	4	1.29	2	SH
Hesperoperla pacifica	3	0.97	2	PR
Kogotus sp.	3	0.97	2	PR
Total Plecoptera	**14**	**4.52**		
Brachycentrus americanus	1	0.32	1	OM
Glossosoma sp.	31	10.00	1	SC
Rhyacophila narvae	4	1.29	1	PR
Neophylax occidentis	7	2.26	1	SC
Total Trichoptera	**43**	**13.87**		
Heterlimnius sp.	49	15.81	4	CG
Optioservus sp.	2	0.65	4	SC
Total Coleoptera	**51**	**16.45**		
Glutops sp.	1	0.32	3	PR
Dicranota sp.	1	0.32	3	PR
Rhabdomastix sp.	1	0.32	3	UN
Total Diptera	**3**	**0.97**		
Micropsectra sp.	4	1.29	7	CG
Orthocladius sp.	11	3.55	6	CG
Pagastia sp.	4	1.29	1	CG
Total Chironomidae	**19**	**6.13**		
Grand Total	**310**	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: Arrastra Creek **Site ID: AraC-02 6/21/01**

TOTAL ABUNDANCE	310
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	204
TOTAL NUMBER OF TAXA	29
Number EPT taxa	16

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	5	33	10.65
Odonata	0	0	0.00
Ephemeroptera	8	147	47.42
Plecoptera	4	14	4.52
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	4	43	13.87
Lepidoptera	0	0	0.00
Coleoptera	2	51	16.45
Diptera	3	3	0.97
Chironomidae	3	19	6.13

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	10.74

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	6	16	5.16
Parasite	1	1	0.32
Collector-gatherer	13	119	38.39
Collector-filterer	0	0	0.00
Macrophyte-herbivore	0	0	0.00
Piercer-herbivore	0	0	0.00
Scraper	6	168	54.19
Shredder	1	4	1.29
Xylophage	0	0	0.00
Omnivore	1	1	0.32
Unknown	1	1	0.32

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	#DIV/0!
Scraper/(Scraper + C.filterer)	1.00
Shredder/Total organisms	0.00

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Cinygmula sp.	102	32.90
Heterlimnius sp.	49	15.81
Glossosoma sp.	31	10.00
Epeorus longimanus	25	8.06
Eiseniella tetraedra	18	5.81
SUBTOTAL 5 DOMINANTS	225	72.58
Sphaeriidae	12	3.87
Baetis tricaudatus	11	3.55
Orthocladius sp.	11	3.55
Neophylax occidentis	7	2.26
Ephemerella inermis	4	1.29
TOTAL DOMINANTS	270	87.10

SAPROBIC INDICES

Hilsenhoff Biotic Index	3.71

DIVERSITY MEASURES

Shannon H (loge)	2.02
Shannon H (log2)	2.92
Evenness	0.60
Simpson D	0.13

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	25	7.90
Univoltine	223	71.77
Semivoltine	63	20.32

	#TAXA	ABUNDANCE	PERCENT
Tolerant	2	13	4.19
Intolerant	4	12	3.87
Clinger	13	231	74.52

Aquatic Invertebrate Taxonomic Data

Site Name: Backfoot River
Site ID: BlckftR-03 6/26/01

Approx. percent of sample used: 37

Taxon	Quantity	Percent	HBI	FFG
Ophiogomphus sp.	1	0.31	4	PR
Total Odonata	**1**	**0.31**		
Acentrella turbida	7	2.15	4	CG
Baetis tricaudatus	3	0.92	6	CG
Diphetor hageni	1	0.31	5	CG
Caudatella heterocaudata	2	0.61	1	CG
Drunella coloradensis	4	1.23	0	CG
Ephemerella inermis	76	23.31	1	CG
Serratella tibialis	15	4.60	2	CG
Epeorus albertae	2	0.61	1	SC
Nixe sp.	2	0.61	2	SC
Rhithrogena sp.	13	3.99	0	SC
Total Ephemeroptera	**125**	**38.34**		
Suwallia sp.	1	0.31	0	PR
Doroneuria sp.	8	2.45	1	PR
Hesperoperla pacifica	6	1.84	2	PR
Isoperla sp.	3	0.92	2	PR
Pteronarcys californica	8	2.45	1	OM
Total Plecoptera	**26**	**7.98**		
Brachycentrus americanus	2	0.61	1	OM
Brachycentrus occidentalis	112	34.36	1	OM
Glossosoma sp.	2	0.61	1	SC
Hydropsyche sp.	16	4.91	4	CF
Oecetis sp.	3	0.92	8	OM
Neophylax occidentis	1	0.31	1	SC
Total Trichoptera	**136**	**41.72**		
Optioservus sp.	11	3.37	4	SC
Total Coleoptera	**11**	**3.37**		
Atherix sp.	1	0.31	4	PR
Simulium sp.	4	1.23	6	CF
Limnophila sp.	1	0.31	6	MH
Total Diptera	**6**	**1.84**		
Eukiefferiella Devonica Gr.	8	2.45	4	OM
Orthocladius sp.	9	2.76	6	CG
Paratanytarsus sp.	3	0.92	6	UN
Thienemanniella sp.	1	0.31	6	CG
Total Chironomidae	**21**	**6.44**		
Grand Total	**326**	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: Backfoot River **Site ID: BlckftR-03 6/26/01**

TOTAL ABUNDANCE	326
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	287
TOTAL NUMBER OF TAXA	30
Number EPT taxa	21

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	0	0	0.00
Odonata	1	1	0.31
Ephemeroptera	10	125	38.34
Plecoptera	5	26	7.98
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	6	136	41.72
Lepidoptera	0	0	0.00
Coleoptera	1	11	3.37
Diptera	3	6	1.84
Chironomidae	4	21	6.44

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	13.67

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	6	20	6.13
Parasite	0	0	0.00
Collector-gatherer	9	118	36.20
Collector-filterer	2	20	6.13
Macrophyte-herbivore	1	1	0.31
Piercer-herbivore	0	0	0.00
Scraper	6	31	9.51
Shredder	0	0	0.00
Xylophage	0	0	0.00
Omnivore	5	133	40.80
Unknown	1	3	0.92

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	1.55
Scraper/(Scraper + C.filterer)	0.61
Shredder/Total organisms	0.00

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Brachycentrus occidentali.	112	34.36
Ephemerella inermis	76	23.31
Hydropsyche sp.	16	4.91
Serratella tibialis	15	4.60
Rhithrogena sp.	13	3.99
SUBTOTAL 5 DOMINANTS	232	71.17
Optioservus sp.	11	3.37
Orthocladius sp.	9	2.76
Doroneuria sp.	8	2.45
Pteronarcys californica	8	2.45
Eukiefferiella Devonica Gr	8	2.45
TOTAL DOMINANTS	276	84.66

SAPROBIC INDICES

Hilsenhoff Biotic Index	1.83

DIVERSITY MEASURES

Shannon H (loge)	1.97
Shannon H (log2)	2.84
Evenness	0.58
Simpson D	0.15

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	28	8.59
Univoltine	150	46.01
Semivoltine	148	45.40

	#TAXA	ABUNDANCE	PERCENT
Tolerant	4	18	5.52
Intolerant	2	9	2.76
Clinger	15	270	82.82

Aquatic Invertebrate Taxonomic Data

Site Name: Blackfoot River
Site ID: BlckftR-01 6/21/01

Approx. percent of sample used: 100

Taxon	Quantity	Percent	HBI	FFG
Sweltsa sp.	3	3.80	1	PR
Doroneuria sp.	1	1.27	1	PR
Total Plecoptera	**4**	**5.06**		
Brachycentrus americanus	3	3.80	1	OM
Rhyacophila Angelita Gr.	1	1.27	0	PR
Total Trichoptera	**4**	**5.06**		
Heterlimnius sp.	24	30.38	4	CG
Zaitzevia sp.	2	2.53	4	CG
Total Coleoptera	**26**	**32.91**		
Tabanidae	2	2.53	8	PR
Antocha sp.	1	1.27	3	CG
Limnophila sp.	9	11.39	6	MH
Rhabdomastix sp.	2	2.53	3	UN
Total Diptera	**14**	**17.72**		
Eukiefferiella Devonica Gr.	3	3.80	4	OM
Orthocladius sp.	5	6.33	6	CG
Pagastia sp.	2	2.53	1	CG
Parametriocnemus sp.	6	7.59	5	CG
Polypedilum sp.	15	18.99	6	OM
Total Chironomidae	**31**	**39.24**		
Grand Total	79	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: Blackfoot River **Site ID: BlckftR-01 6/21/01**

TOTAL ABUNDANCE	79
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	8
TOTAL NUMBER OF TAXA	15
Number EPT taxa	4

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	0	0	0.00
Odonata	0	0	0.00
Ephemeroptera	0	0	0.00
Plecoptera	2	4	5.06
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	2	4	5.06
Lepidoptera	0	0	0.00
Coleoptera	2	26	32.91
Diptera	4	14	17.72
Chironomidae	5	31	39.24

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	0.26

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	4	7	8.86
Parasite	0	0	0.00
Collector-gatherer	6	40	50.63
Collector-filterer	0	0	0.00
Macrophyte-herbivore	1	9	11.39
Piercer-herbivore	0	0	0.00
Scraper	0	0	0.00
Shredder	0	0	0.00
Xylophage	0	0	0.00
Omnivore	3	21	26.58
Unknown	1	2	2.53

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	#DIV/0!
Scraper/(Scraper + C.filterer)	#DIV/0!
Shredder/Total organisms	0.00

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Heterlimnius sp.	24	30.38
Polypedilum sp.	15	18.99
Limnophila sp.	9	11.39
Parametriocnemus sp.	6	7.59
Orthocladius sp.	5	6.33
SUBTOTAL 5 DOMINANTS	59	74.68
Sweltsa sp.	3	3.80
Brachycentrus americanus	3	3.80
Eukiefferiella Devonica Gr.	3	3.80
TOTAL DOMINANTS	68	86.08

SAPROBIC INDICES

Hilsenhoff Biotic Index	4.48

DIVERSITY MEASURES

Shannon H (loge)	2.21
Shannon H (log2)	3.18
Evenness	0.81
Simpson D	0.15

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	23	29.43
Univoltine	25	31.96
Semivoltine	31	38.61

	#TAXA	ABUNDANCE	PERCENT
Tolerant	3	13	16.46
Intolerant	2	3	3.80
Clinger	6	46	58.23

Aquatic Invertebrate Taxonomic Data

Site Name: Sandbar Creek
Site ID: SbrC-01 6/18/01

Approx. percent of sample used: 100

Taxon	Quantity	Percent	HBI	FFG
Diphetor hageni	2	2.47	5	CG
Drunella spinifera	4	4.94	0	PR
Ephemerella inermis	1	1.23	1	CG
Serratella tibialis	1	1.23	2	CG
Cinygma sp.	1	1.23	2	SC
Cinygmula sp.	9	11.11	4	SC
Total Ephemeroptera	**18**	**22.22**		
Suwallia sp.	1	1.23	0	PR
Sweltsa sp.	23	28.40	1	PR
Despaxia augusta	1	1.23	0	SH
Visoka cataractae	1	1.23	0	SH
Zapada Oregonensis Gr.	1	1.23	2	SH
Doroneuria sp.	1	1.23	1	PR
Total Plecoptera	**28**	**34.57**		
Micrasema sp.	8	9.88	1	MH
Rhyacophila Betteni Gr.	2	2.47	1	PR
Rhyacophila Brunnea Gr.	5	6.17	1	PR
Total Trichoptera	**15**	**18.52**		
Heterlimnius sp.	5	6.17	4	CG
Narpus sp.	1	1.23	4	CG
Zaitzevia sp.	1	1.23	4	CG
Total Coleoptera	**7**	**8.64**		
Prosimulium sp.	1	1.23	3	CF
Dicranota sp.	1	1.23	3	PR
Total Diptera	**2**	**2.47**		
Eukiefferiella Pseudomontana Gr.	1	1.23	8	OM
Micropsectra sp.	5	6.17	7	CG
Microtendipes sp.	2	2.47	6	CG
Pagastia sp.	1	1.23	1	CG
Parametriocnemus sp.	2	2.47	5	CG
Total Chironomidae	**11**	**13.58**		
Grand Total	**81**	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: Sandbar Creek **Site ID: SbrC-01 6/18/01**

TOTAL ABUNDANCE	81
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	61
TOTAL NUMBER OF TAXA	25
Number EPT taxa	15

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	0	0	0.00
Odonata	0	0	0.00
Ephemeroptera	6	18	22.22
Plecoptera	6	28	34.57
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	3	15	18.52
Lepidoptera	0	0	0.00
Coleoptera	3	7	8.64
Diptera	2	2	2.47
Chironomidae	5	11	13.58

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	5.55

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	7	37	45.68
Parasite	0	0	0.00
Collector-gatherer	10	21	25.93
Collector-filterer	1	1	1.23
Macrophyte-herbivore	1	8	9.88
Piercer-herbivore	0	0	0.00
Scraper	2	10	12.35
Shredder	3	3	3.70
Xylophage	0	0	0.00
Omnivore	1	1	1.23
Unknown	0	0	0.00

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	10.00
Scraper/(Scraper + C.filterer)	0.91
Shredder/Total organisms	0.05

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Sweltsa sp.	23	28.40
Cinygmula sp.	9	11.11
Micrasema sp.	8	9.88
Rhyacophila Brunnea Gr.	5	6.17
Heterlimnius sp.	5	6.17
SUBTOTAL 5 DOMINANTS	50	61.73
Micropsectra sp.	5	6.17
Drunella spinifera	4	4.94
Diphetor hageni	2	2.47
Rhyacophila Betteni Gr.	2	2.47
Microtendipes sp.	2	2.47
TOTAL DOMINANTS	65	80.25

SAPROBIC INDICES

Hilsenhoff Biotic Index	2.37

DIVERSITY MEASURES

Shannon H (loge)	2.62
Shannon H (log2)	3.78
Evenness	0.81
Simpson D	0.11

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	10	12.04
Univoltine	60	73.77
Semivoltine	12	14.20

	#TAXA	ABUNDANCE	PERCENT
Tolerant	2	2	2.47
Intolerant	3	3	3.70
Clinger	12	39	48.15

Aquatic Invertebrate Taxonomic Data

Site Name: Sandbar Creek
Site ID: SbrC-02 6/18/01

Approx. percent of sample used: 100

Taxon	Quantity	Percent	HBI	FFG
Capnia sp.	4	11.43	1	SH
Sweltsa sp.	10	28.57	1	PR
Despaxia augusta	2	5.71	0	SH
Zapada frigida	1	2.86	2	SH
Doroneuria sp.	1	2.86	1	PR
Total Plecoptera	**18**	**51.43**		
Ceratopogoninae	3	8.57	6	PR
Pedicia sp.	2	5.71	6	PR
Total Diptera	**5**	**14.29**		
Diamesa sp.	7	20.00	5	CG
Orthocladius sp.	4	11.43	6	CG
Polypedilum sp.	1	2.86	6	OM
Total Chironomidae	**12**	**34.29**		
Grand Total	**35**	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: Sandbar Creek **Site ID: SbrC-02 6/18/01**

TOTAL ABUNDANCE	35
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	18
TOTAL NUMBER OF TAXA	10
Number EPT taxa	5

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	0	0	0.00
Odonata	0	0	0.00
Ephemeroptera	0	0	0.00
Plecoptera	5	18	51.43
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	0	0	0.00
Lepidoptera	0	0	0.00
Coleoptera	0	0	0.00
Diptera	2	5	14.29
Chironomidae	3	12	34.29

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	1.50

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	4	16	45.71
Parasite	0	0	0.00
Collector-gatherer	2	11	31.43
Collector-filterer	0	0	0.00
Macrophyte-herbivore	0	0	0.00
Piercer-herbivore	0	0	0.00
Scraper	0	0	0.00
Shredder	3	7	20.00
Xylophage	0	0	0.00
Omnivore	1	1	2.86
Unknown	0	0	0.00

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	#DIV/0!
Scraper/(Scraper + C.filterer)	#DIV/0!
Shredder/Total organisms	0.57

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Sweltsa sp.	10	28.57
Diamesa sp.	7	20.00
Capnia sp.	4	11.43
Orthocladius sp.	4	11.43
Ceratopogoninae	3	8.57
SUBTOTAL 5 DOMINANTS	28	80.00
Despaxia augusta	2	5.71
Pedicia sp.	2	5.71
Zapada frigida	1	2.86
Doroneuria sp.	1	2.86
TOTAL DOMINANTS	34	97.14

SAPROBIC INDICES

Hilsenhoff Biotic Index	3.20

DIVERSITY MEASURES

Shannon H (loge)	2.02
Shannon H (log2)	2.91
Evenness	0.88
Simpson D	#DIV/0!

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	9	25.71
Univoltine	25	71.43
Semivoltine	1	2.86

	#TAXA	ABUNDANCE	PERCENT
Tolerant	0	0	0.00
Intolerant	3	4	11.43
Clinger	1	1	2.86

Aquatic Invertebrate Taxonomic Data

Site Name: Willow Creek
Site ID: WilC-01 6/19/01

Approx. percent of sample used: 87

Taxon	Quantity	Percent	HBI	FFG
Polycelis caronata	2	0.63	4	CG
Eiseniella tetraedra	66	20.89	8	CG
Sphaeriidae	3	0.95	8	CG
Total Misc. Taxa	**71**	**22.47**		
Baetis tricaudatus	2	0.63	6	CG
Diphetor hageni	1	0.32	5	CG
Ephemerella inermis	6	1.90	1	CG
Cinygmula sp.	18	5.70	4	SC
Paraleptophlebia temporalis	23	7.28	4	CG
Total Ephemeroptera	**50**	**15.82**		
Capnia sp.	1	0.32	1	SH
Sweltsa sp.	1	0.32	1	PR
Zapada columbiana	1	0.32	2	SH
Hesperoperla pacifica	10	3.16	2	PR
Total Plecoptera	**13**	**4.11**		
Arctopsyche grandis	1	0.32	1	PR
Micrasema sp.	8	2.53	1	MH
Hydroptila sp.	4	1.27	6	PH
Eocosmoecus schmidi	1	0.32	0	OM
Rhyacophila Brunnea Gr.	2	0.63	1	PR
Total Trichoptera	**16**	**5.06**		
Cleptelmis addenda	12	3.80	4	CG
Heterlimnius sp.	4	1.27	4	CG
Lara avara	1	0.32	4	SH
Narpus sp.	2	0.63	4	CG
Optioservus sp.	1	0.32	4	SC
Total Coleoptera	**20**	**6.33**		
Ceratopogoninae	1	0.32	6	PR
Chelifera sp.	4	1.27	6	PR
Prosimulium sp.	2	0.63	3	CF
Simulium sp.	4	1.27	6	CF
Dicranota sp.	2	0.63	3	PR
Tipula sp.	1	0.32	4	OM
Total Diptera	**14**	**4.43**		
Cladotanytarsus sp.	7	2.22	7	CG
Cricotopus sp.	4	1.27	7	CG
Cricotopus nostococladius	8	2.53	3	PH
Eukiefferiella Devonica Gr.	16	5.06	4	OM
Eukiefferiella Pseudomontana Gr.	8	2.53	8	OM
Pagastia sp.	30	9.49	1	CG
Parametriocnemus sp.	2	0.63	5	CG
Polypedilum sp.	8	2.53	6	OM
Rheocricotopus sp.	1	0.32	6	OM
Rheotanytarsus sp.	46	14.56	6	CF
Thienemannimyia Gr.	2	0.63	6	PR
Total Chironomidae	**132**	**41.77**		
Grand Total	**316**	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: Willow Creek **Site ID: WilC-01 6/19/01**

TOTAL ABUNDANCE	316
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	79
TOTAL NUMBER OF TAXA	39
Number EPT taxa	14

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	3	71	22.47
Odonata	0	0	0.00
Ephemeroptera	5	50	15.82
Plecoptera	4	13	4.11
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	5	16	5.06
Lepidoptera	0	0	0.00
Coleoptera	5	20	6.33
Diptera	6	14	4.43
Chironomidae	11	132	41.77

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	0.60

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	8	23	7.28
Parasite	0	0	0.00
Collector-gatherer	14	164	51.90
Collector-filterer	3	52	16.46
Macrophyte-herbivore	1	8	2.53
Piercer-herbivore	2	12	3.80
Scraper	2	19	6.01
Shredder	3	3	0.95
Xylophage	0	0	0.00
Omnivore	6	35	11.08
Unknown	0	0	0.00

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	0.37
Scraper/(Scraper + C.filterer)	0.27
Shredder/Total organisms	0.00

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Eiseniella tetraedra	66	20.89
Rheotanytarsus sp.	46	14.56
Pagastia sp.	30	9.49
Paraleptophlebia temporalis	23	7.28
Cinygmula sp.	18	5.70
SUBTOTAL 5 DOMINANTS	183	57.91
Eukiefferiella Devonica Gr.	16	5.06
Cleptelmis addenda	12	3.80
Hesperoperla pacifica	10	3.16
Micrasema sp.	8	2.53
Cricotopus nostococladius	8	2.53
TOTAL DOMINANTS	237	75.00

SAPROBIC INDICES

Hilsenhoff Biotic Index	4.96

DIVERSITY MEASURES

Shannon H (loge)	2.88
Shannon H (log2)	4.15
Evenness	0.79
Simpson D	0.09

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	106	33.62
Univoltine	175	55.46
Semivoltine	35	10.92

	#TAXA	ABUNDANCE	PERCENT
Tolerant	5	27	8.54
Intolerant	3	10	3.16
Clinger	16	123	38.92

Aquatic Invertebrate Taxonomic Data

Site Name: Willow Creek
Site ID: WilC-02 6/21/01

Approx. percent of sample used: 100

Taxon	Quantity	Percent	HBI	FFG
Eiseniella tetraedra	16	5.78	8	CG
Fossaria sp.	4	1.44	6	CG
Acari	3	1.08	5	PA
Total Misc. Taxa	**23**	**8.30**		
Acentrella turbida	2	0.72	4	CG
Baetis tricaudatus	1	0.36	6	CG
Diphetor hageni	1	0.36	5	CG
Drunella coloradensis	2	0.72	0	CG
Cinygmula sp.	8	2.89	4	SC
Epeorus longimanus	8	2.89	1	SC
Rhithrogena sp.	3	1.08	0	SC
Total Ephemeroptera	**25**	**9.03**		
Sweltsa sp.	12	4.33	1	PR
Hesperoperla pacifica	2	0.72	2	PR
Kogotus sp.	4	1.44	2	PR
Total Plecoptera	**18**	**6.50**		
Brachycentrus americanus	1	0.36	1	OM
Micrasema sp.	3	1.08	1	MH
Hydropsyche sp.	4	1.44	4	CF
Lepidostoma sp.-sand case larvae	3	1.08	1	SH
Rhyacophila Brunnea Gr.	1	0.36	1	PR
Neophylax splendens	6	2.17	2	SC
Total Trichoptera	**18**	**6.50**		
Cleptelmis addenda	1	0.36	4	CG
Dubiraphia sp.	1	0.36	6	CG
Heterlimnius sp.	116	41.88	4	CG
Narpus sp.	3	1.08	4	CG
Optioservus sp.	22	7.94	4	SC
Zaitzevia sp.	19	6.86	4	CG
Total Coleoptera	**162**	**58.48**		
Glutaps sp.	2	0.72	3	PR
Antocha sp.	4	1.44	3	CG
Rhabdomastix sp.	4	1.44	3	UN
Total Diptera	**10**	**3.61**		
Cladotanytarsus sp.	6	2.17	7	CG
Cricotopus nostococladius	7	2.53	3	PH
Cryptotendipes sp.	1	0.36	6	UN
Eukiefferiella Devonica Gr.	1	0.36	4	OM
Microtendipes sp.	1	0.36	6	CG
Orthocladius sp.	5	1.81	6	CG
Total Chironomidae	**21**	**7.58**		
Grand Total	**277**	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: Willow Creek **Site ID: WilC-02 6/21/01**

TOTAL ABUNDANCE	277
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	61
TOTAL NUMBER OF TAXA	34
Number EPT taxa	16

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	3	23	8.30
Odonata	0	0	0.00
Ephemeroptera	7	25	9.03
Plecoptera	3	18	6.50
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	6	18	6.50
Lepidoptera	0	0	0.00
Coleoptera	6	162	58.48
Diptera	3	10	3.61
Chironomidae	6	21	7.58

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	2.90

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	5	21	7.58
Parasite	1	3	1.08
Collector-gatherer	15	182	65.70
Collector-filterer	1	4	1.44
Macrophyte-herbivore	1	3	1.08
Piercer-herbivore	1	7	2.53
Scraper	5	47	16.97
Shredder	1	3	1.08
Xylophage	0	0	0.00
Omnivore	2	2	0.72
Unknown	2	5	1.81

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	11.75
Scraper/(Scraper + C.filterer)	0.92
Shredder/Total organisms	0.00

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Heterlimnius sp.	116	41.88
Optioservus sp.	22	7.94
Zaitzevia sp.	19	6.86
Eiseniella tetraedra	16	5.78
Sweltsa sp.	12	4.33
SUBTOTAL 5 DOMINANTS	185	66.79
Cinygmula sp.	8	2.89
Epeorus longimanus	8	2.89
Cricotopus nostococladius	7	2.53
Neophylax splendens	6	2.17
Cladotanytarsus sp.	6	2.17
TOTAL DOMINANTS	220	79.42

SAPROBIC INDICES

Hilsenhoff Biotic Index	3.88

DIVERSITY MEASURES

Shannon H (loge)	2.10
Shannon H (log2)	3.03
Evenness	0.60
Simpson D	0.16

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	23	8.21
Univoltine	89	32.04
Semivoltine	166	59.75

	#TAXA	ABUNDANCE	PERCENT
Tolerant	7	49	17.69
Intolerant	4	17	6.14
Clinger	17	206	74.37